

Rapid Ethanol Fermenter Design

Matthew Williams, Kalven Metz, Isaac Wilson, Daniel Kang, and Kevin Kruger

Fostail BioSystems has designed and patented a novel rapid fermentation bead system that needs to be tested and proven for industrial applications. These beads have shown to be effective for bench-top scale fermentation and microbrewery purposes, but their full potential will likely require a specially designed fermenter tailored to the design of the beads.

Problem Definition

To have a fully functional 150-300 gallon ethanol fermenter tailored specifically for the use of the BioEx beads and being capable of operating industrially.

Project Goal

- Temperature
- Sugar concentration
- Mass of beads per sugar solution
- Alcohol content

Major Parameters

Current Design Specifications

Total Volume	119 gallons
Process	Batch
Operating Temperature	70-100° F Optimal (95°)
Fermentation Time	~2 hours
Initial Sugar Concentration	16% (yields 9.4% ethanol by volume)
Solution Volume	65 gallons

Wet to dry ratio	~3:1
Expansion	5.23 x dehydrated volume 33% expansion when actively fermenting
Loading	300g dry per Liter of solution
Displacement	1.22 liters per liter of solution at full eating capacity
Change in Displacement	

Bead Specifications

Bags

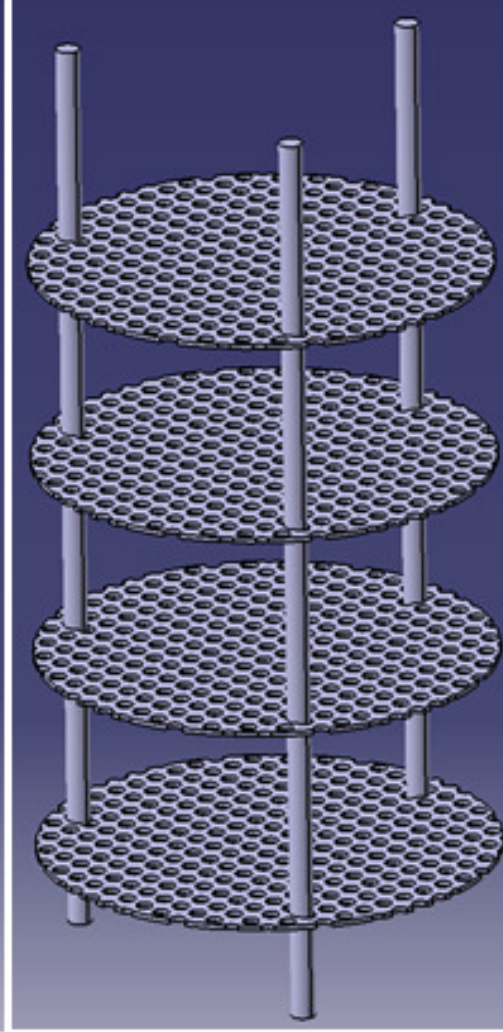
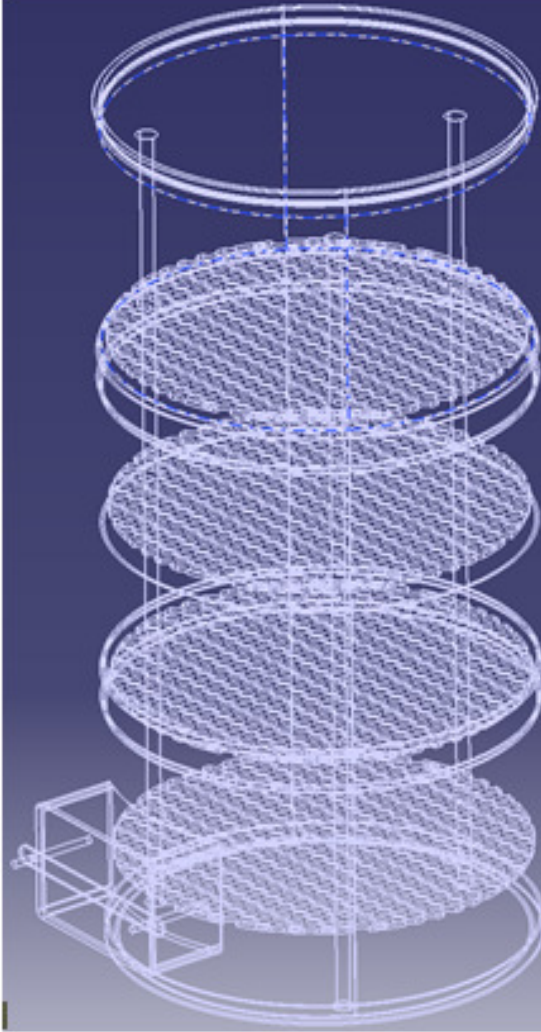
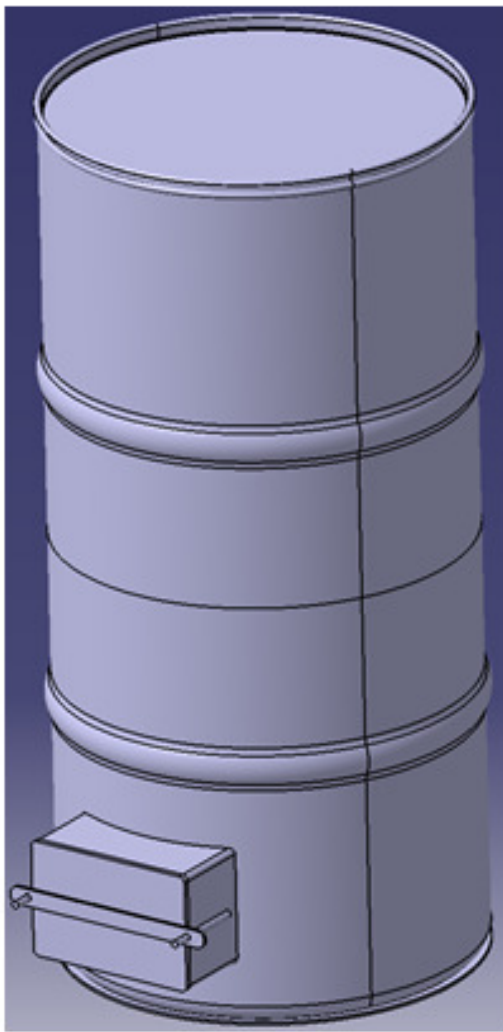
Loading per bag	1.5 kg wet beads 500g dry beads

Challenges Identified



- Beads migrating across layers
- Head space loss due to expansion
- Loading and unloading problematic
- Reaction is exothermic ~ 6400 btu of heat per barrel reaction
- Dead zone at the bottom of the reaction vessel ~10 degree temperature change

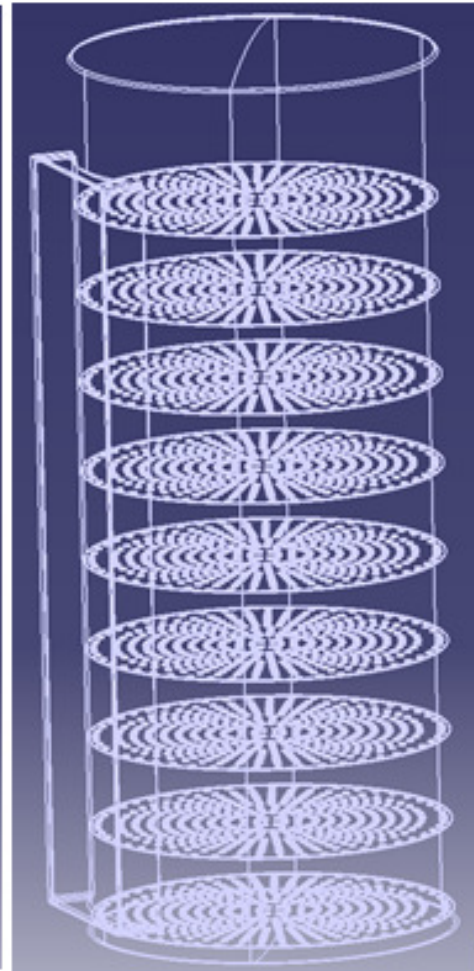
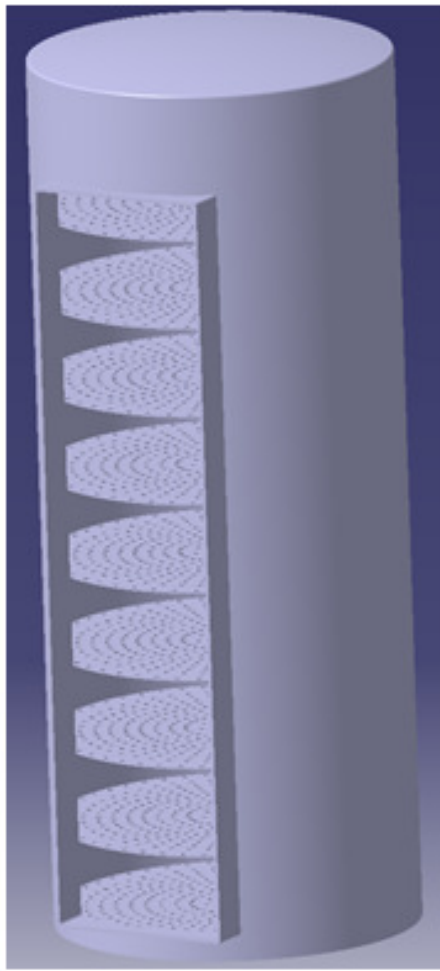
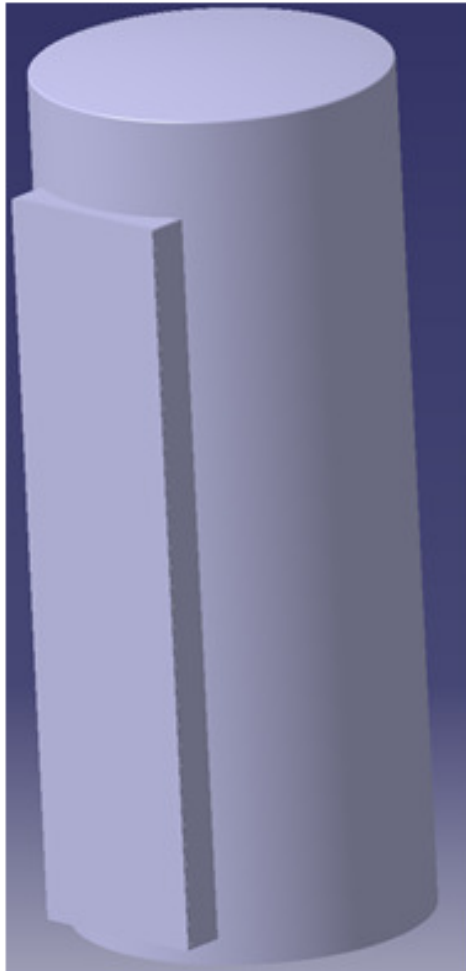
Final Prototype

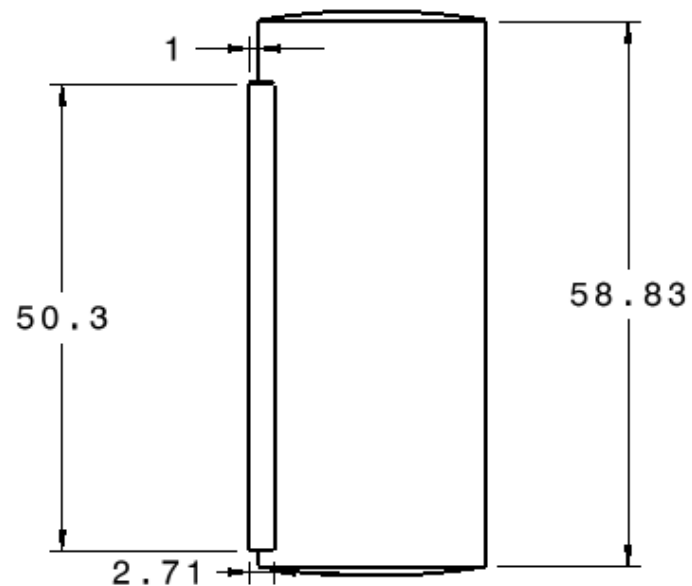
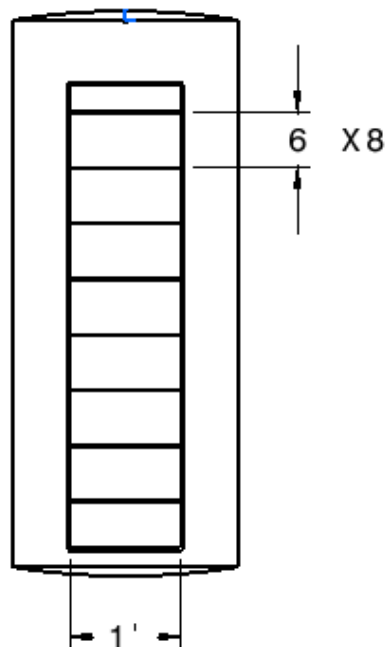
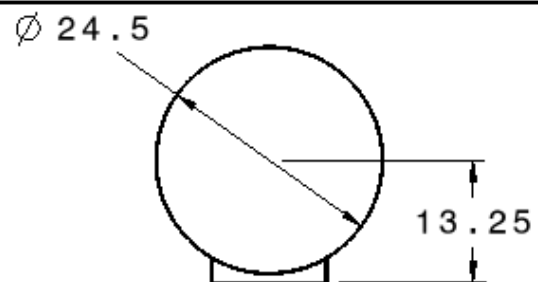


Prototype	
Volume	63.04 L 16.67 gal
Dimensions	14 in base in height
Racks	Drop in system Made from expanded metal
Final Design	
119	119 gal
Dimensions	24.5 in base 59 in height
Racks	Welded in system Made from expanded Aluminum

Scaling up from Prototype to Final Design

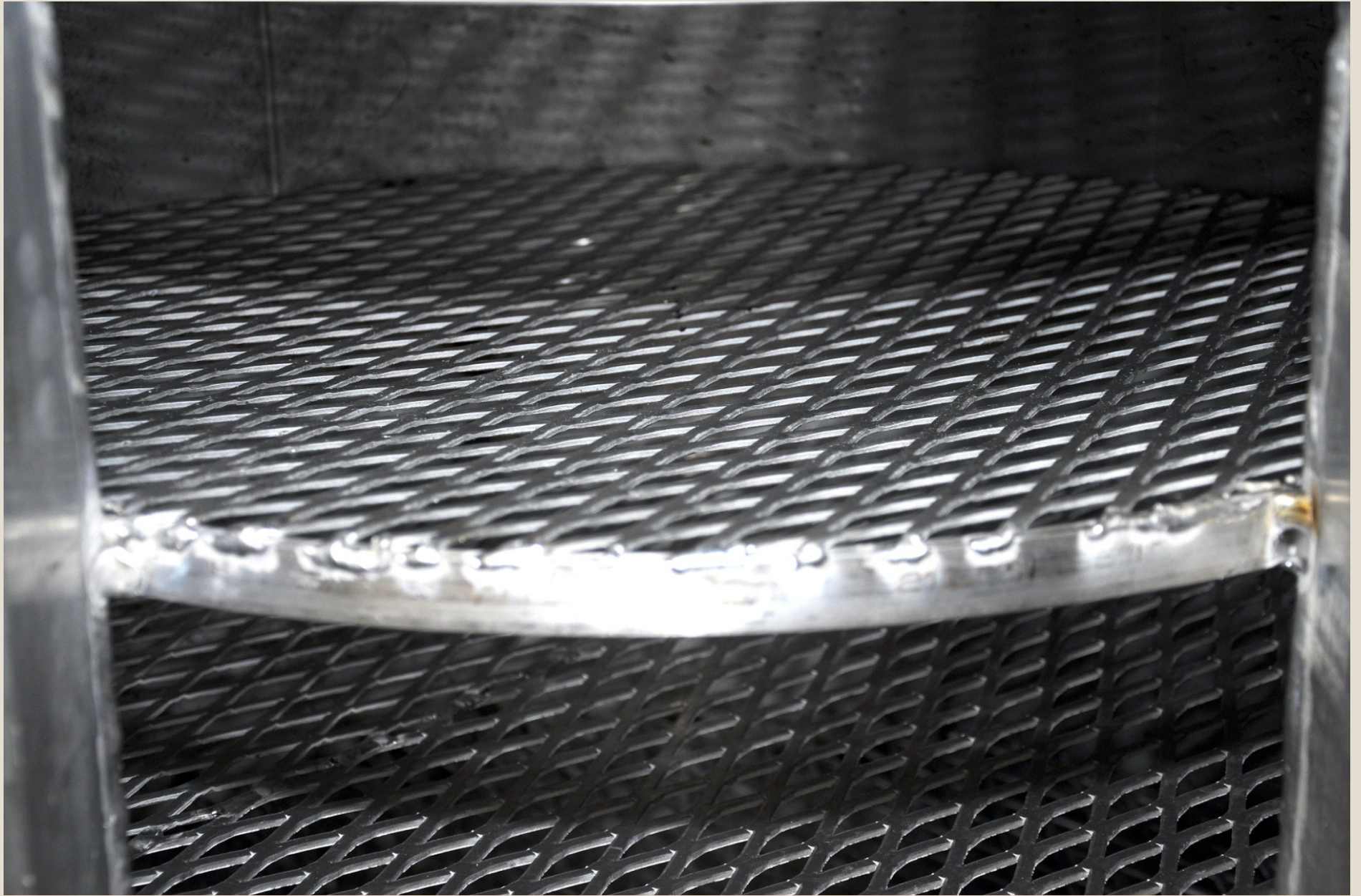
Final Design





DIMENSIONS ARE IN INCHES THIRD ANGLE PROJECTIONS				DESCRIPTION:		<i>Final Design</i>	
LINEAR TOLERANCES: X. ± 0.25 X.X ± 0.1 X.XX ± 0.01 X.XXX ± 0.002		ANGULAR TOLERANCES: X. ± 2 X.X ± 1 X.XX ± 0.30°		DRAWN BY: ISAAC WILSON		DATE: 2/25/2014	
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UNIVERSITY OF IDAHO STANDARD TEMPLATE: FALL 2013				FILE NAME: FINAL DESIGN.CATPART		SCALE: 1:1	
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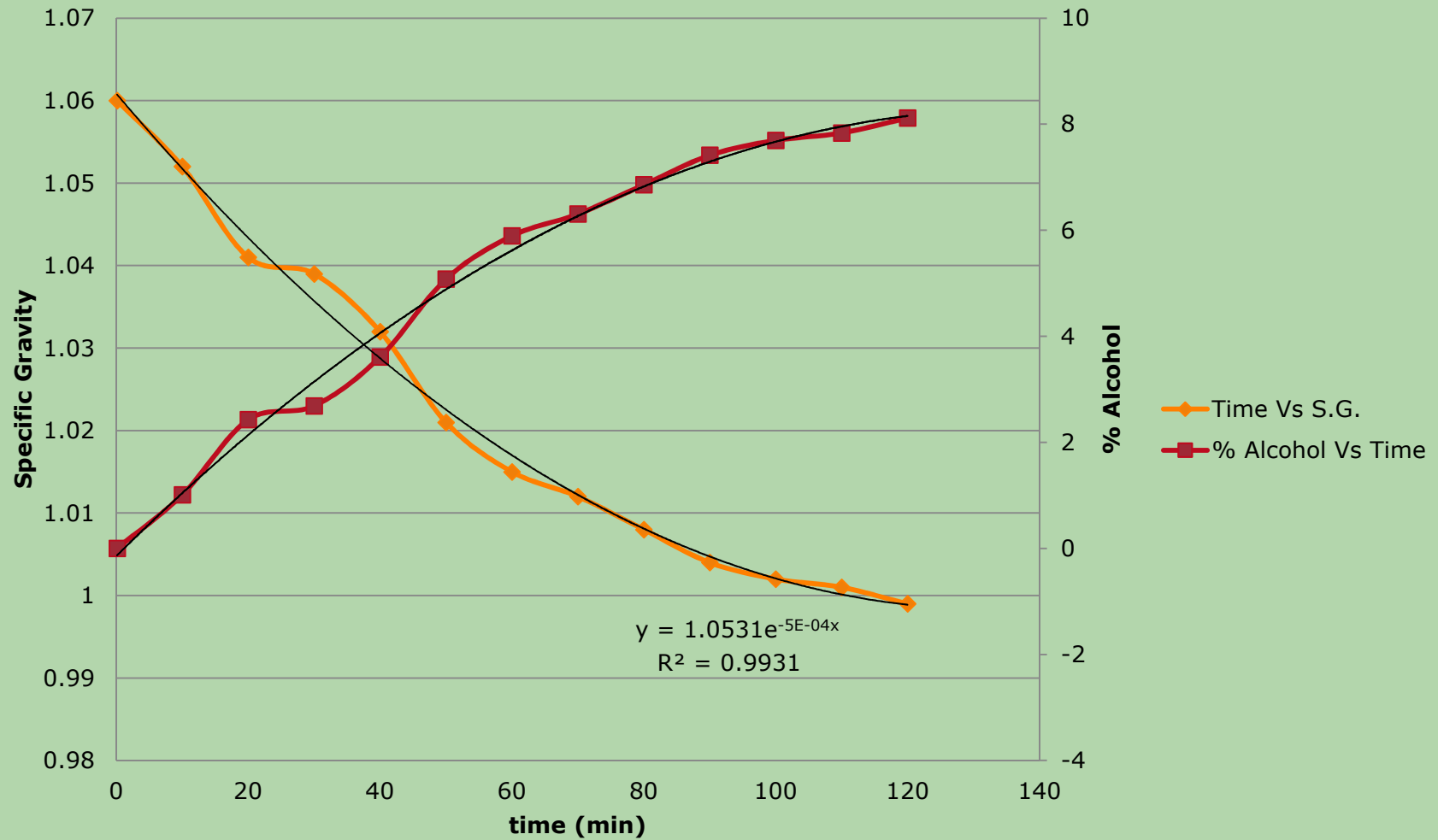




- 120 gal Aluminum Tank \$2000
- Fabrication/Materials \$1900
- Pump \$556
- Fittings/Hoses \$60
- Total \$4516

Product Cost

S.G. and Alcohol Content



Questions?

